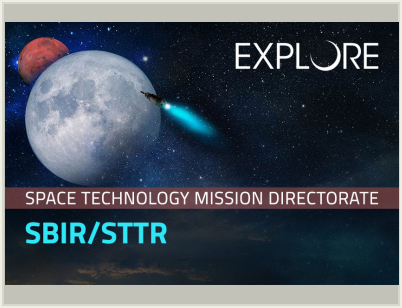
Low Heat-Leak YBCO Leads for Satellite-Borne ADR Magnets, Phase I

Completed Technology Project (2012 - 2012)

Project Introduction

Future satellite missions carrying X-ray spectrometers will be cooled to milliKelvin temperatures by multi-stage Adiabatic Demagnetization Refrigerators (ADR), which, in turn will be precooled by closed-cycle cryocoolers. Each stage of the ADR will use a low temperature superconducting magnet, which will periodically be energized via high temperature superconducting (HTS) leads. The present design of leads contributes a large fraction of the total heat load on the cryogenics system and so we propose to fabricate Yttria Barium Copper Oxide (YBCO) lead assemblies with a predicted heat load of about one order of magnitude lower than the established design that uses brittle filaments supported on a glass-fiber tube. Our suggested approach is to fabricate inherently tough and flexible leads in the 2A to 10A range from commercially available YBCO tape rated to over 200A. The substrates of such tapes are tough, strong low thermal conductivity metals which can be cut longitudinally into thin strips approximately 300 micrometers in width using a precision dicing saw. In principle, leads of any length or width can be made this way and tailored to a variety of specifications. In the region of the thermal gradient, the protective silver coating is removed and replaced by a non-conducting encapsulant; the as-manufactured silver coating is left at the ends to make electrical joints. This is a process which should lend itself well to small-scale manufacture. The strength and toughness of the leads means that they can be incorporated into a loom supported by taught Kevlar threads, which is a very low heat-leak method used extensively in space cryogenics. We expect that the overall result of this project will be to reduce significantly the size, weight and power requirement of the satellite-borne cryosystem and at the same time produce a lighter more robust lead structure.



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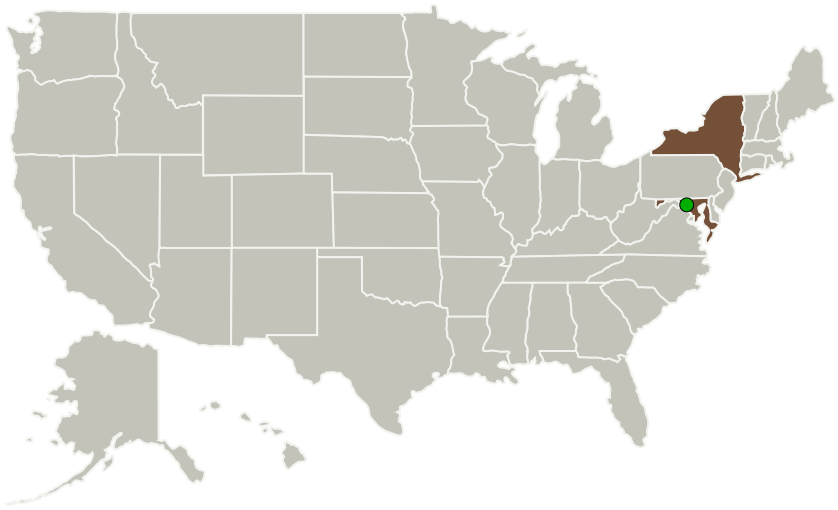
Small Business Innovation Research/Small Business Tech Transfer

Low Heat-Leak YBCO Leads for Satellite-Borne ADR Magnets, Phase I

Completed Technology Project (2012 - 2012)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
HYPRES, Inc.	Lead Organization	Industry	Elmsford, New York
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Maryland	New York

Project Transitions

February 2012: Project Start

August 2012: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138268)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

HYPRES, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Robert J Webber

Co-Investigator:

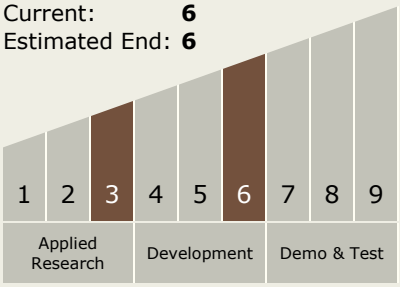
Robert Webber

Low Heat-Leak YBCO Leads for Satellite-Borne ADR Magnets, Phase I

Completed Technology Project (2012 - 2012)

Technology Maturity (TRL)

Start: **3**
Current: **6**
Estimated End: **6**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.6 Cryogenic / Thermal

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System